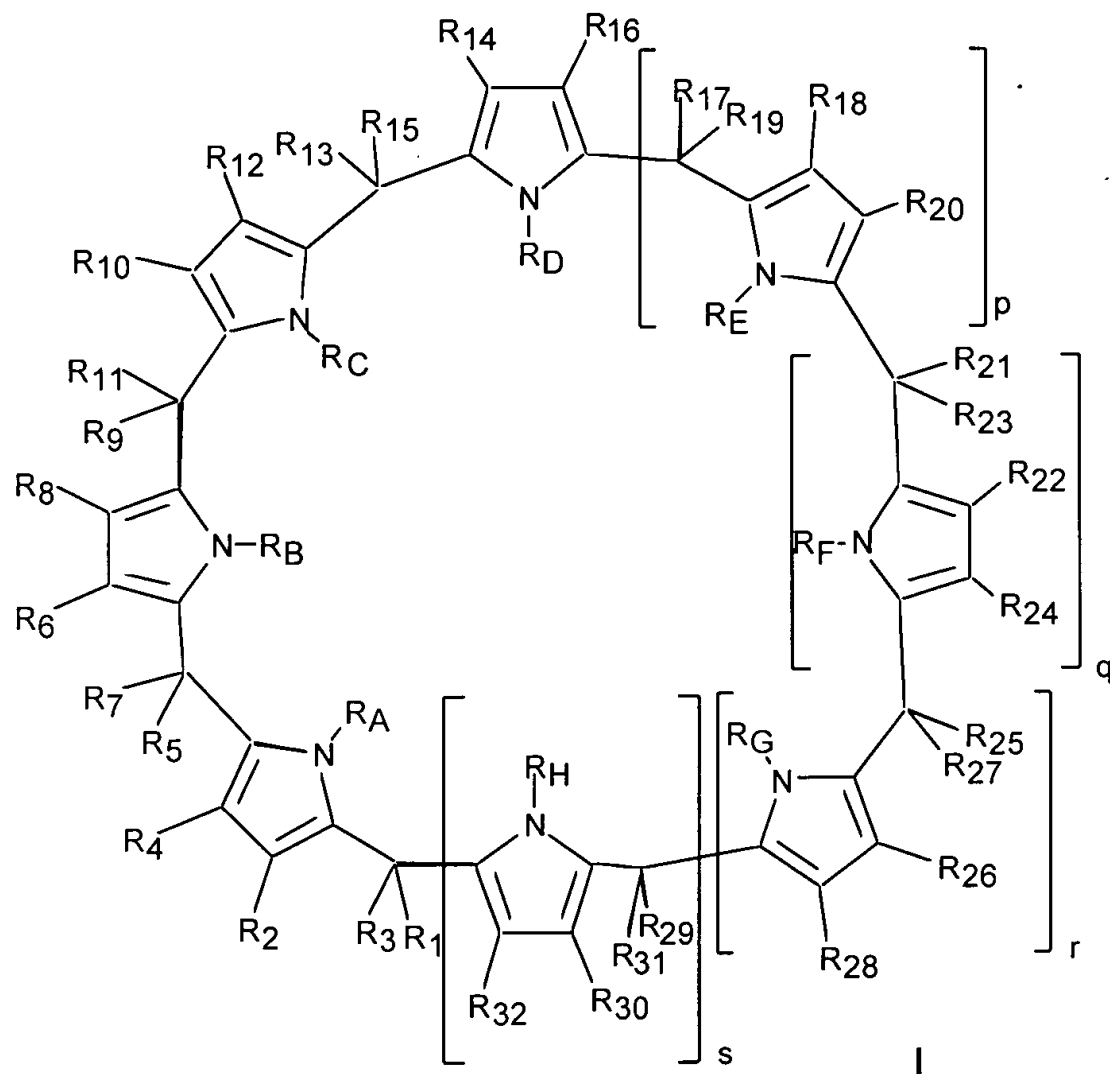


WHAT IS CLAIMED IS:

1. A compound comprising a  $\beta$ -substituted calix[n]pyrrole macrocycle having structure I:

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wherein n is 4, 5, 6, 7, or 8; and

when n is 4;  $p = q = r = s = 0$ , even numbered R substituents are fluoro, chloro, or bromo, odd numbered R substituents are independently as listed in paragraph i) below, and  $R_A - R_D$  are independently substituents as listed in paragraph ii) below;

when n is 5;  $p = 1$ ,  $q = r = s = 0$ , even numbered R substituents are fluoro, chloro, or bromo, odd numbered R substituents are independently as listed in paragraph

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i) below, and  $R_A - R_E$  are independently substituents as listed in paragraph ii) below;

when  $n$  is 6;  $p = q = 1$ ,  $r = s = 0$ , even numbered  $R$  substituents are fluoro, chloro, or bromo, odd numbered  $R$  substituents are independently as listed in paragraph i) below, and  $R_A - R_F$  are independently substituents as listed in paragraph ii) below;

when  $n$  is 7;  $p = q = r = 1$ ,  $s = 0$ , even numbered  $R$  substituents are fluoro, chloro, or bromo, odd numbered  $R$  substituents are independently as listed in paragraph i) below, and  $R_A - R_G$  are independently substituents as listed in paragraph ii) below;

when  $n$  is 8;  $p = q = r = s = 1$ , even numbered  $R$  substituents are fluoro, chloro, or bromo, odd numbered  $R$  substituents are independently as listed in paragraph i) below, and  $R_A - R_H$  are independently substituents as listed in paragraph ii) below;

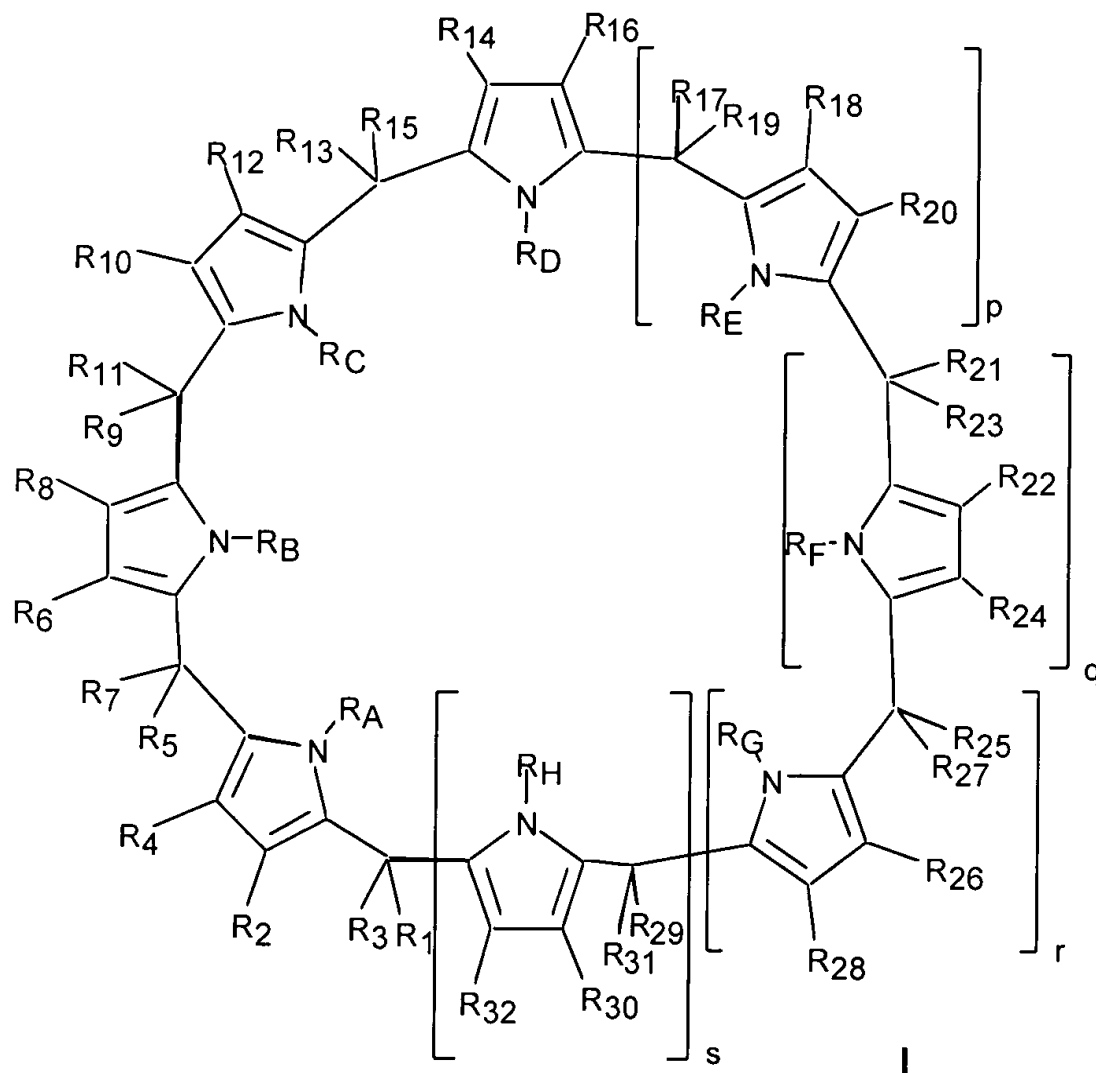
i) alkyl, alkenyl, alkynyl, aryl, alkylaryl, formyl, acyl, hydroxyalkyl, hydroxyalkoxy, hydroxyalkenyl, hydroxyalkynyl, saccharide, carboxy, carboxyalkyl, carboxyamide, carboxyamidealkyl, alkyl sulfoxide, alkyl sulfone, alkyl sulfide, tetrahydropyran, tetrahydrothiapyran, thioalkyl, haloalkyl, haloalkenyl, haloalkynyl, alkyl ester, a site-directing molecule, a catalytic group, a reporter group, a binding agent, or a couple that is coupled to a site-directing molecule, to a catalytic group, to a reporter group, or to a binding agent;

ii) hydrogen, alkyl, aminoalkyl, alkylsulfone, carboxy alkyl, carboxyamidealkyl, phospho alkyl, alkyl sulfoxide, alkyl sulfone, alkyl sulfide, haloalkyl, aryl, N-oxide, dialkylamino, carbamate, or arylsulfonyl.

2. The compound of Claim 1 wherein  $n$  is 4 and  $p = q = r = s = 0$ .

3. The compound of Claim 1 wherein at least two R substituents are coupled to form a bridged structure, the two R substituents selected from the group consisting of an odd numbered R substituent and a pyrrole R substituent, and when coupled to form a bridged structure, nonbridged substituents are as defined.

4. A compound comprising a  $\beta$ -substituted calix[n]pyrrole macrocycle having structure I:



wherein

- 10  $n$  is 4;  $p = q = r = s = 0$ ; even numbered R substituents are fluoro, odd numbered R substituents are alkyl, and  $R_A - R_D$  are hydrogen.

5. A composition comprising the compound of Claim 1 incorporated into a polymer matrix.

6. A composition comprising the compound of Claim 1 incorporated into a membrane.

7. A composition comprising the compound of Claim 1 incorporated into a liposome.

8. A compound comprising a fluorinated calix[n]pyrrole where n is 9, 10, 11, or 12.

9. The compound of Claim 1 wherein n is 5.

10. The compound of Claim 1 wherein n is 6 or 7.

11. The compound of Claim 1 wherein n is 8.

12. A method of making a halogenated calix[n]pyrrole where n is 4, 5, 6, 7, 8, 9, 10, 11, or 12 comprising  
reacting 3,4-dihalopyrrole and a ketone molecule for a time sufficient to produce the  
halogenated calix[n]pyrrole.

13. The method of Claim 12 wherein the halogenated calix[n]pyrrole is a fluorinated  
calix[n]pyrrole and the 3,4-dihalopyrrole is a 3,4-difluoropyrrole.

14. A method of removing an anion from an environment containing the anion comprising  
contacting the environment with a halogenated calix[n]pyrrole where n is 4, 5, 6, 7, or 8 wherein  
the halogenated calix[n]pyrrole binds the anion thereby removing the anion from the environment.

15. The method of Claim 14 wherein the anion is an environmental pollutant.

16. The method of Claim 14 wherein the anion is fluoride, chloride, or phosphate.

17. The method of Claim 14 wherein the anion is pertechnetate.

18. A method for extracting an ion pair having a cation associated with an anion from an  
environment containing said ion pair, the method comprising contacting the environment with an

anion coextractant and a cation coextractant, wherein the anion coextractant is a calix[n]pyrrole where n is 4, 5, 6, 7, or 8, and wherein the calix[n]pyrrole binds the anion and the cation coextractant binds the cation thereby allowing for removal of the ion pair from the environment.

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19. The method of Claim 18 wherein the calix[n]pyrrole is a halogenated calix[n]pyrrole.

20. The method of Claim 18 wherein the calix[n]pyrrole is a fluorinated calix[n]pyrrole.

10 21. The method of Claim 18 wherein the ion pair is an environmental pollutant.

22. The method of Claim 18 wherein the cation coextractant is a crown ether, a cryptand, a calixarene, a calixarene-crown ether cryptand, or a calixarene-crown ether conjugate.

23. The method of Claim 18 wherein the cation coextractant is a cation exchanger.

24. A method for reducing or preventing corrosion on a substrate susceptible to corrosion in the presence of a corrosion-promoting anion, comprising contacting the substrate with a calix[n]pyrrole where n is 4, 5, 6, 7, or 8 wherein the calix[n]pyrrole binds the corrosion-promoting anion, thereby reducing or preventing corrosion of the substrate.

25. The method of Claim 24 wherein the calix[n]pyrrole is a halogenated calix[n]pyrrole.

26. The method of Claim 24 wherein the calix[n]pyrrole is a fluorinated calix[n]pyrrole.

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27. The method of Claim 24 wherein the substrate is gasoline or jet fuel and the anion is a chloride anion.

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28. A method for producing a naked cation in a solution containing said cation paired with an anion, the method comprising contacting a calix[n]pyrrole where n is 4, 5, 6, 7, or 8 with the solution, wherein the calix[n]pyrrole binds the anion thereby providing the naked cation.

29. The method of Claim 18 wherein the cation is cesium.

30. A compound selected from the group consisting of compounds 44, 46, 48, 50, and 52.

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